

## Low Power Broadband Low-Noise Amplifiers from 1-300GHz

Completed Technology Project (2012 - 2012)



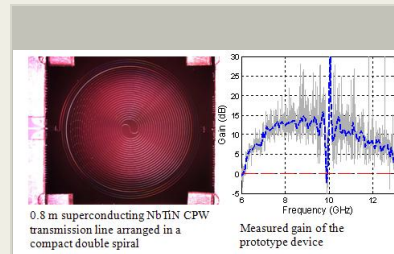
## Project Introduction

A few key technology areas are moving to the use of cryogenic detectors and require state-of-the-art cryogenic amplifiers. For example, nanowire sensors for optical communication ground stations achieve 30 psec timing resolution not available in other detector technologies. Focal planes for astrophysics are driving toward megapixel arrays to do both spectroscopy and multi-object observations of targets at high Z. These applications require a back-end amplifier with high bandwidth (1-10GHz).

A number of low noise amplifier technologies exist at a variety of maturity levels and with a variety of strengths and limitations. The most mature amplifier technologies are semiconducting amplifier (InP HEMT or SiGe). The InP HEMTs have the lowest noise above several GHz, and are available commercially. However, more advanced InP HEMT ICs are only available to those with specialized knowledge and contacts with industry. By contrast the SiGe circuits have lower noise below two GHz and can be manufactured as complex mixed signal circuits integrating low-noise bipolar amplifiers with CMOS. Like InP, simple commercial SiGe amplifiers are readily available, but the more complex ICs requires a designer and the use of a commercial fabrication line. One benefit of this workshop will be introducing cryogenic technologists to these specialized designers of InP and SiGe ICs, in order to form new partnerships. Along with these semi-commercial technologies there are several new amplifier concepts still in the research phase including superconducting parametric amplifiers and RF/Microwave SQUID amplifiers. These amplifier technologies offer the possibility of quantum limited noise at frequencies as high as 300 GHz, but since they are research topics themselves they are not generally available. Again by bringing the researches working on these less developed technologies together with end-users we hope to create opportunities for collaboration. In general, the use of low-noise and quantum limited amplifiers can improve the sensitivity of many instruments and enable new ones. Some of these amplifier technologies are already being used in detector systems, but many are new or may be of benefit to additional NASA projects. This workshop will allow cryogenic instrument builders and amplifier experts learn about these technologies and find new opportunities for collaboration.

## Anticipated Benefits

None.



Project Image Low Power Broadband Low-Noise Amplifiers from 1-300GHz

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## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

### Responsible Program:

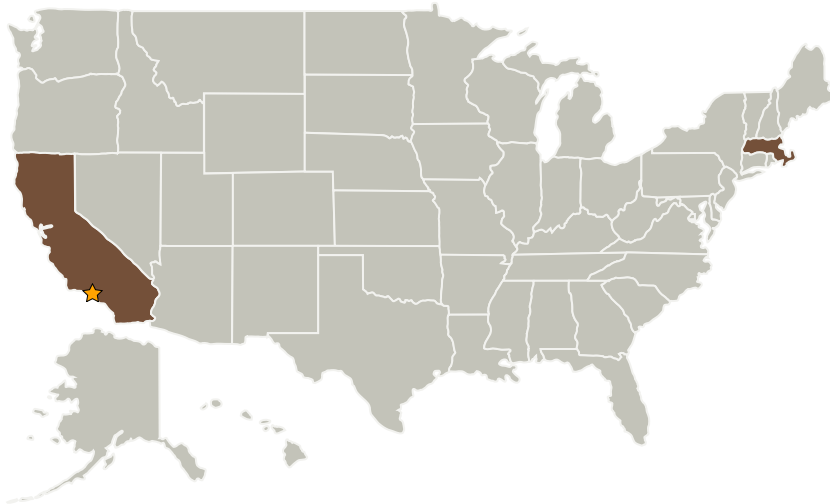
Center Innovation Fund: JPL CIF

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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Co-Funding Partners	Type	Location
California Institute of Technology(CalTech)	Academia	Pasadena, California
University of California-Santa Cruz	Academia	Santa Cruz, California
University of Massachusetts-Amherst(UMASS)	Academia	Amherst, Massachusetts

Primary U.S. Work Locations	
California	Massachusetts

## Project Management

**Program Director:**

Michael R Lapointe

**Program Manager:**

Fred Y Hadaegh

**Project Manager:**

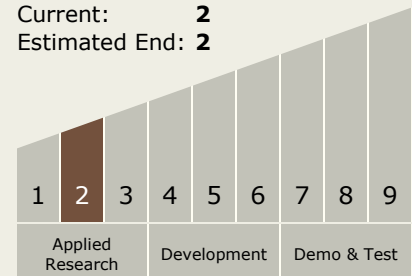
Jonas Zmuidzinas

**Principal Investigator:**

Jeffrey A Stern

## Technology Maturity (TRL)

Start: 2  
 Current: 2  
 Estimated End: 2



## Technology Areas

**Primary:**

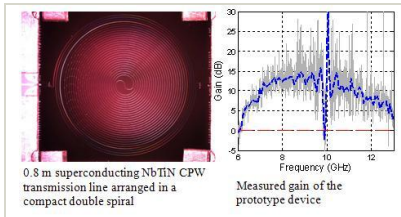
- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
  - TX08.1.2 Electronics

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## Images



**92.jpg**

Project Image Low Power  
Broadband Low-Noise Amplifiers  
from 1-300GHz  
(<https://techport.nasa.gov/image/1179>)